The Pinelands Protection Program
K/C Water Management

Summary of April meeting et al with experts and continued refinement on an approach

8/26/16

Larry Liggett
Director of Land Use

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Study Overview

Current Methods

Discussion with Experts

ASSESSING REGIONAL IMPACTS

Overview

Max. Percent Basin Recharge

Wetland Vulnerability Index

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Cone of Depression Model (Thiem)

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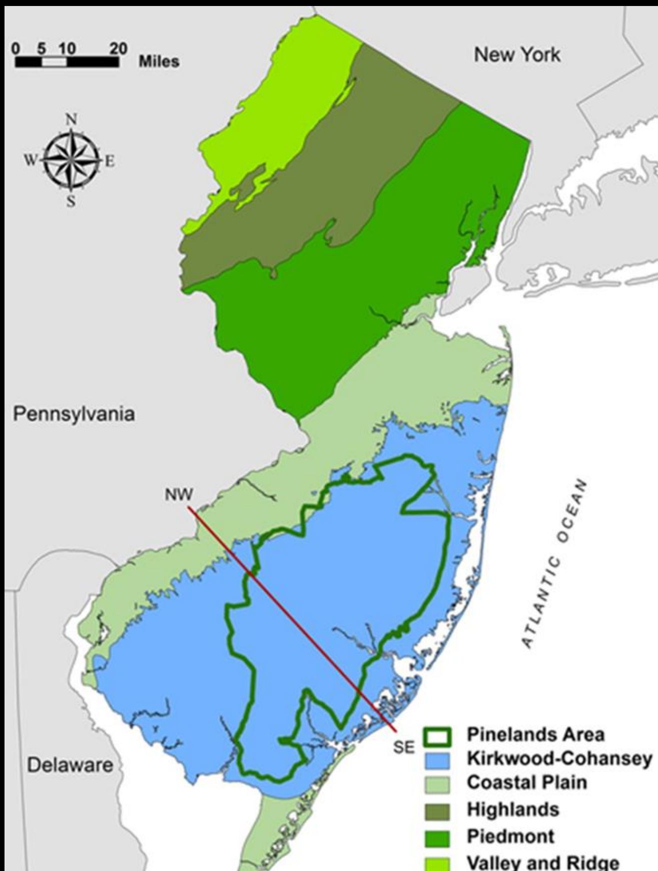
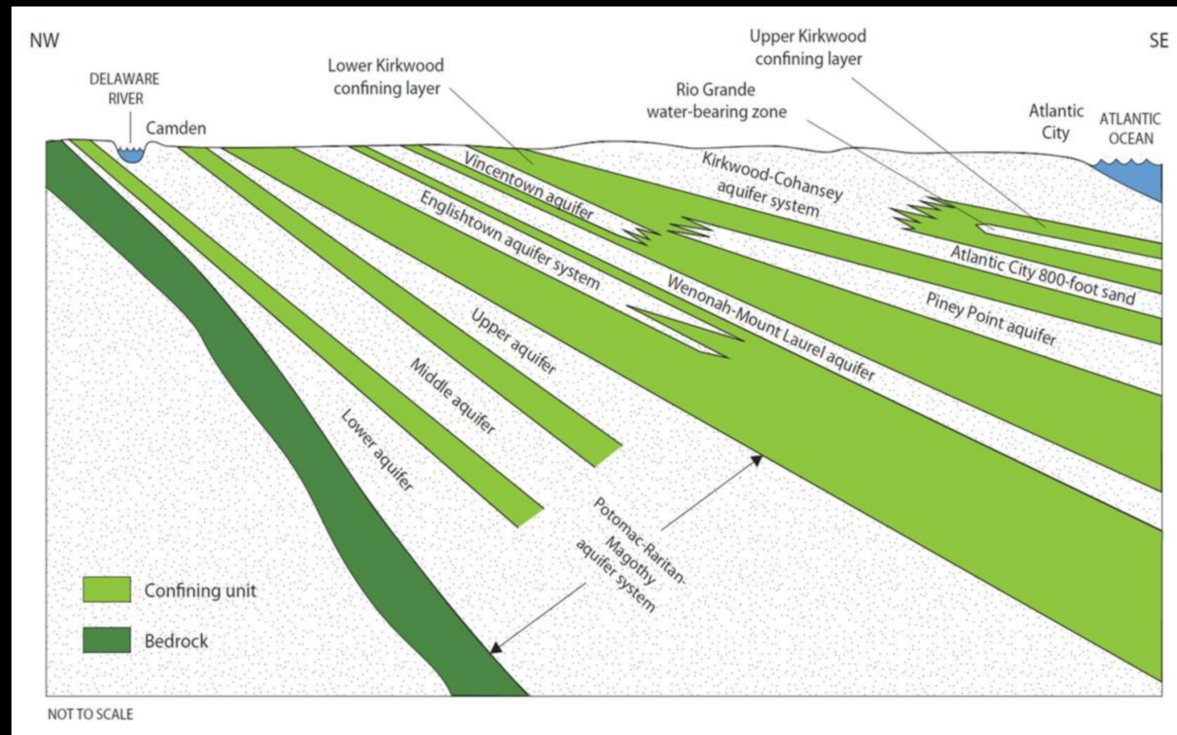
The Kirkwood/Cohansey Project

- **$5 m State Legislation**: "…determine how future water supply needs will be met while protecting the Kirkwood-Cohansey aquifer system and while avoiding any adverse ecological impacts."

- Where is sewer and water permitted in the CMP?
  - 111,000 acres in RGA, Pinelands Towns & Villages
  - Serve upwards of 130,000 new homes (35 mgd of water) plus non-residential

The Kirkwood/Cohansey Aquifer





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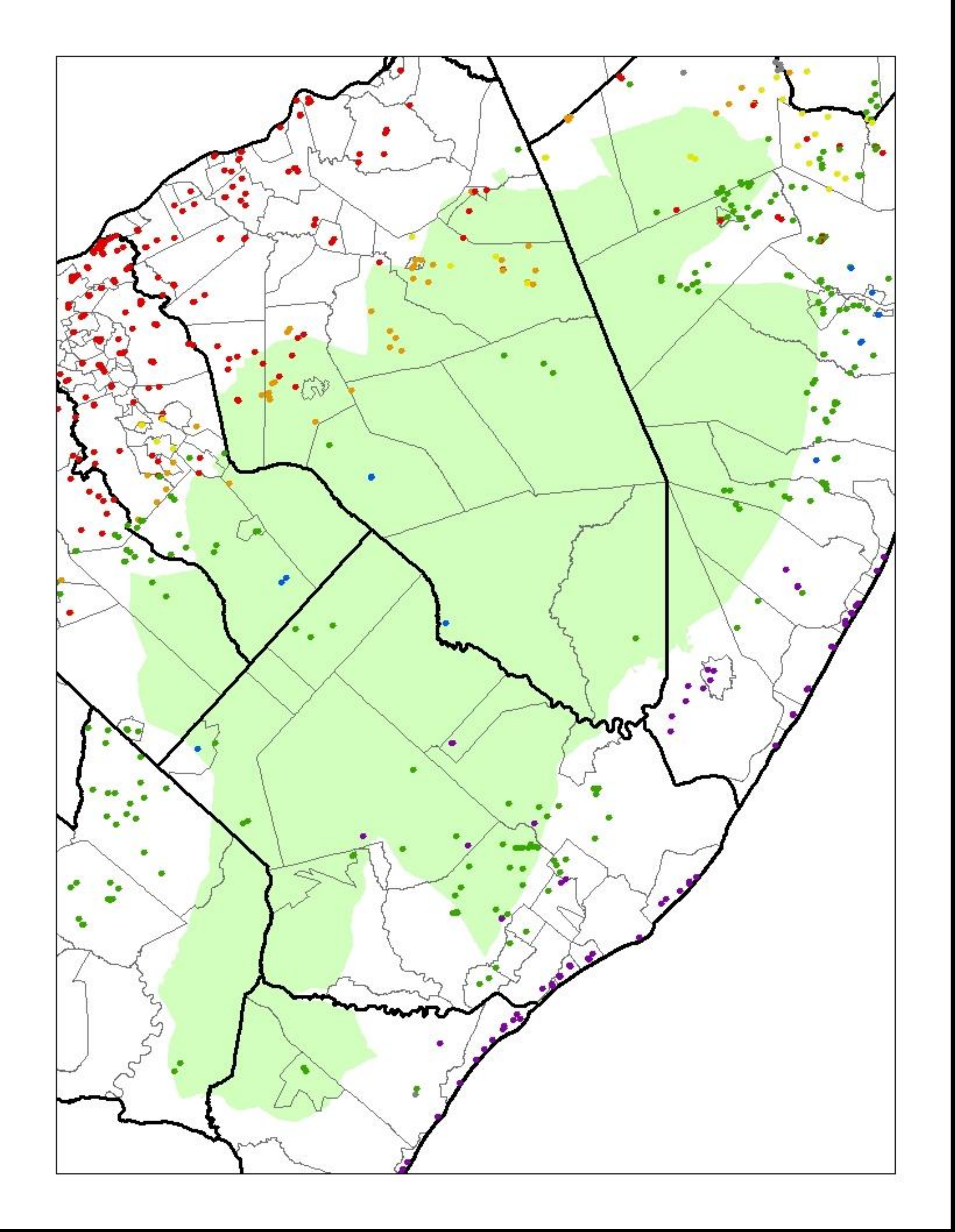
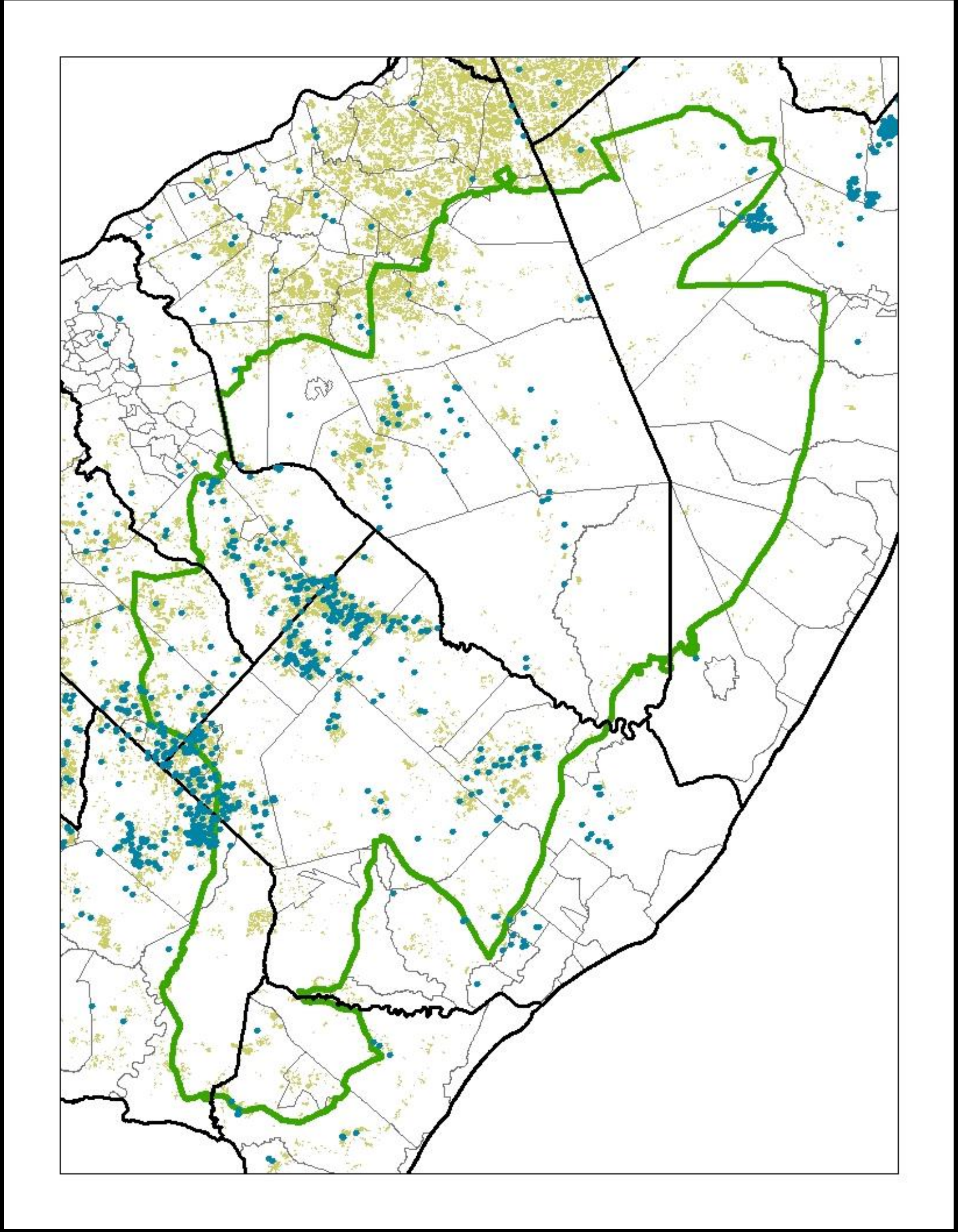
Public Water Supply Wells in the Pinelands



ASSESSING REGIONAL IMPACTS

Overview → Max. % Basin Recharge → WVI → Low-Flow Margin → Basin Size

Agricultural Wells in the Pinelands



ASSESSING REGIONAL IMPACTS

<u>Overview</u> → Max. % Basin Recharge → WVI → Low-Flow Margin → Basin Size

Context: Wells in the Pinelands

- Current:
  - 100 million gallons/day (mgd) or, the equivalent of 100 individual mgd wells
- Future:
  - 40 mgd or, the equivalent of 40 individual mgd wells
  - 4% of daily recharge in Pinelands
- Total:
  - 140 mgd or, the equivalent of 140 individual mgd wells
  - 10% of daily recharge in Pinelands

Current CMP K/C Regulations

- Avoid Inter-basin transfer of water
- No water export beyond 10 miles of boundary
- Include:
  - Water-saving devices and other conservation steps
  - Minimize impacts through well design
  - Distribution system loss reduction
- Permit only if:
  - No viable alternative, or
  - No adverse local or regional ecological impact (this assessment is limited by the absence of specificity and of tools)

Summary of Discussions with Experts
(discussion leaders at one meeting noted below)

- REGIONAL IMPACT CONTROLS (Watershed)
  - Stream Flow Low Flow Margin: Jeff Hoffman, NJ DEP
  - Maximum % of Recharge: Dan Van Abs, Rutgers University
  - Wetlands Vulnerability/Gompertz: Bob Nicholson, USGS
- LOCAL IMPACT CONTROL (wetlands)
  - Cone of Depression Model (Thiem): Bob Nicholson, USGS
- IMPLEMENTING THE CONTROLS
  - Basin Size Selection for Regional Impacts: Joseph Sosik, PC
  - Recharge - Accompany Withdrawals: Jeff Fischer, USGS

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Maximum Percentage of Recharge

Dan Van Abs, Rutgers University

- Long-term recharge is a good proxy for stream flow in a region where most annual average stream flow is derived from ground water.
- Which recharge to use as a maximum?
  - 5% of drought recharge can be removed from a basin (insufficient for an average water supply well)
  - 10% of average recharge (what staff has been using)

Maximum Percentage of Recharge

- Key points:
  - Percentage of average annual does not reflect droughts
  - Percentage of drought flow too restrictive
  - Average annual has been used by the PC for years, but without a scientifically based safe withdrawal limit
  - K/C study can provide specific safe withdrawal limits
- Work involved (if selected)
  - Select a practical measure
  - Set safe withdrawal limit

Wetlands Vulnerability Index

Bob Nicholson, USGS

- – Based on the PC funded study by USGS Charles and Nicholson, 2012
- – Estimates the percentage of wetlands in watersheds that experience reductions in water levels of 5, 10, 15 and 30 centimeters based on varying well withdrawals.

- Example:

Area		Impact of Actual Usage Wetlands Drawdown:		
	Net Withdrawal (MGD)	>= 5 cm	>= 15 cm	>= 30 cm
Hammonton Creek	1.5	73.4%	67.2%	56.2%

Wetlands Vulnerability Index

- <u>Key points</u>:
  - Predicts both regional and local impacts
  - No recommendation for regional withdrawal limits
  - Problematic as it is built upon multiple, layered assumptions
  - A good planning tool, but probably not firm enough for regulatory purposes

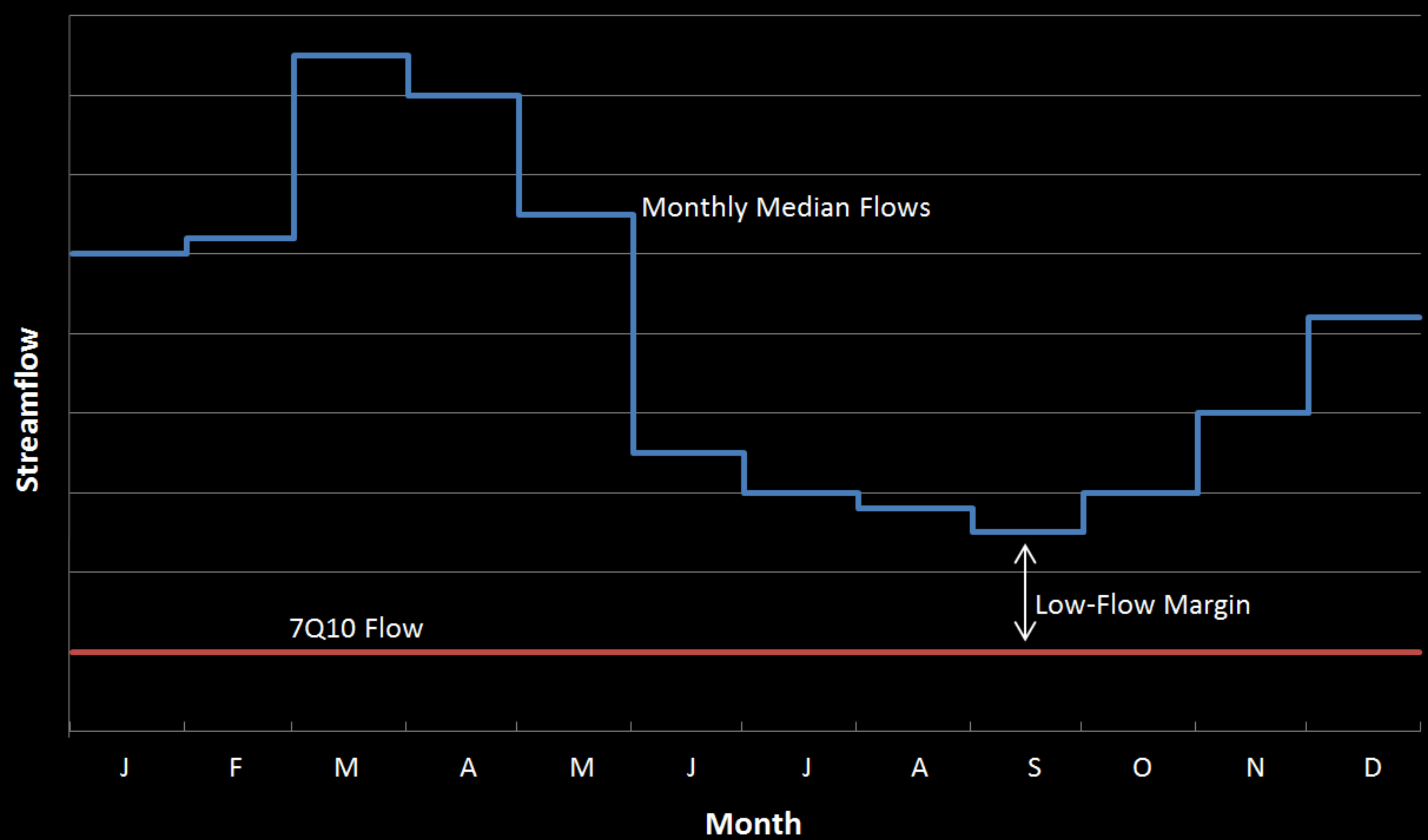
- <u>Work involved</u> (if selected):
  - Gather the necessary data to run the model
  - What are the safe withdrawal limits (regional and local)

The Low-Flow Margin (LFW)

Jeffery Hoffman, DEP

- The low-flow margin is the difference between the September low flow and the 7Q10 drought flow (the lowest 7-day average flow that occurs (on average) once every 10 years.)
- A set percentage of this margin can be safely diverted thereby minimizing impacts

The Low-Flow Margin



ASSESSING REGIONAL IMPACTS

Overview → Max. % Basin Recharge → WVI → Low-Flow Margin → Basin Size

Devising a Low-Flow Threshold

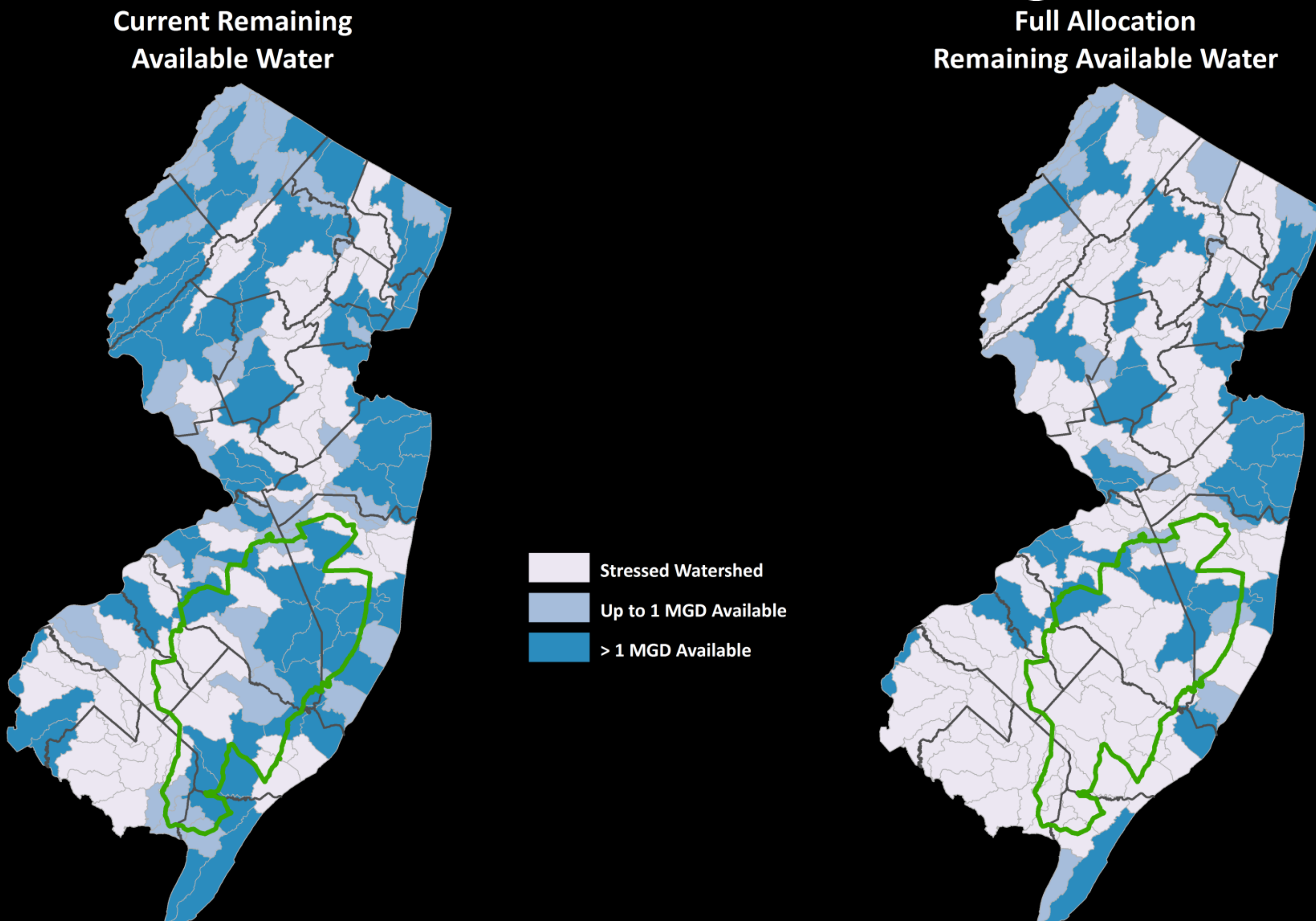
- *How much of the LFM should be available?*
  - *NJ DEP has researched 10 streams state-wide for how much can be withdrawn:*
    - Using currently "stressed" areas. (Results: 20-30% max.)
    - Looking at ecological flow goals (Results: 30-40% maximum)
- *Should the % vary by area sensitivity?*
- *What size basins should it apply to?*

Devising a Low-Flow Threshold

Examples:

- NJ DEP?
  - 25% of the LFM state-wide?
  - Use Large basins? (published data)
- Highlands
  - By area:
    - Protection Zone = 5% of the LFM
    - Conservation Zone = 5%/10% of the LFM
    - Existing Community Zone = 20% of the LFM
  - Uses Small basins (severely limits new wells)

DEP: 25% of Low-Flow of Large Basins



ASSESSING REGIONAL IMPACTS

Overview → Max. % Basin Recharge → WVI → <u>Low-Flow Margin</u> → Basin Size

The Low-Flow Margin

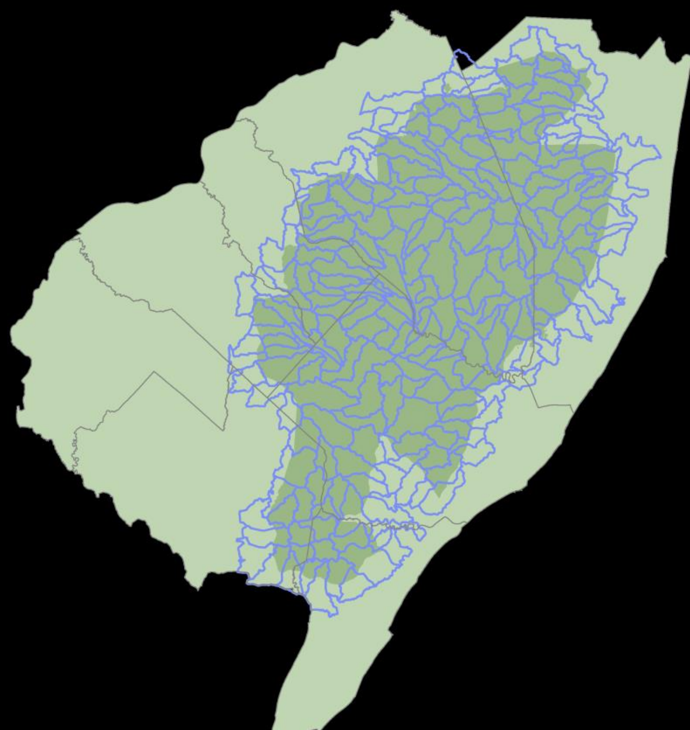
- Key points:
  - Consistent with results of K/C ecological studies
  - Better than just using an average or any particular low flow like the 7Q10,
  - Note: maintaining passing flow (a NJ DEP requirement) is a necessary complementary tool to address severe droughts
  - Basin size needs to be selected

- Work involved:
  - How relevant is the 20-25% threshold to the LFM in the Pinelands?
  - Should the % vary by management area?

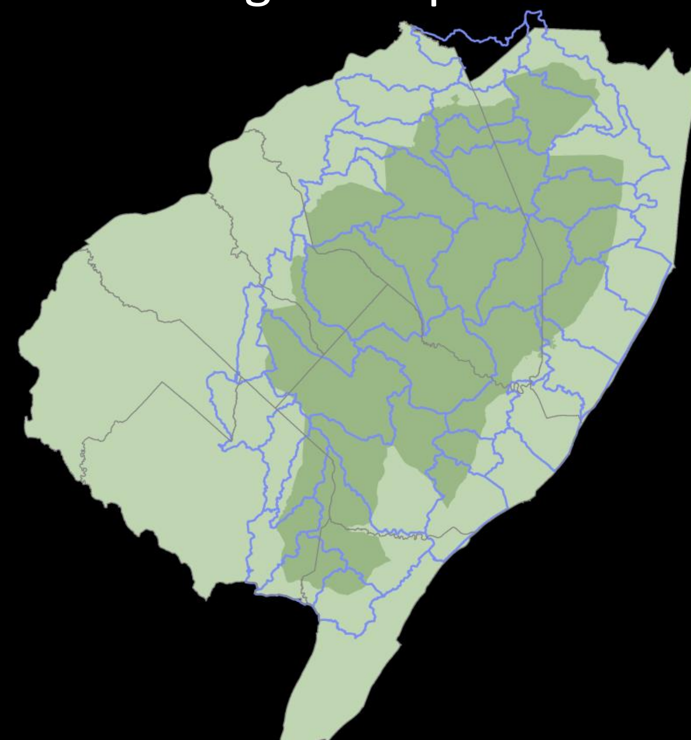
Regional Approach: Basin Sizes

Joseph Sosik, NJ Pinelands Commission

- **"Small" Basins (HUC 14)**
  - 229 with area inside PA
  - Average 9 square miles



- **"Large" Basins (HUC 11)**
  - 37 with area inside PA
  - Average 65 square miles



Regional Approach: Basin Sizes

- Key points:
  - Small basins not feasible/practical for wells
  - Large basins are better suited for the large K/C surface aquifer
  - NJ DEP has published large basin analyses
  - Boundaries of Pinelands watersheds imprecise, therefore better to go with bigger basins
- Work involved:
  - Select larger basins; use DEP data

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Managing Local Impacts

Goal: Better Measure Impacts of pumping near wetlands

- What new ecological metrics can we derive from the K/C study?
  - Maximum drawdown thresholds

- Can we practically regulate with these metrics?
  - Cone of depression model (Thiem) as a screen coupled with enhanced pump tests

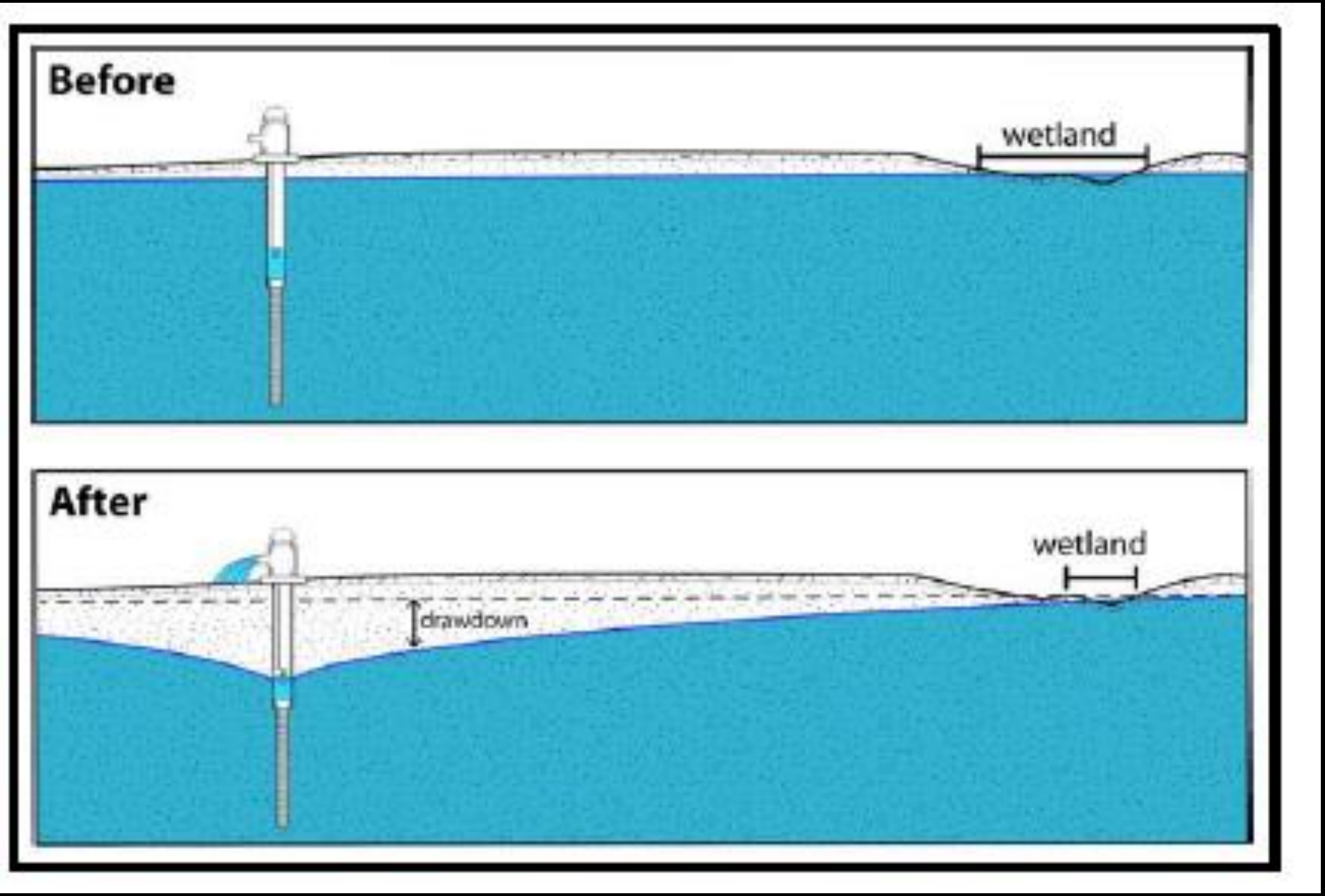
Cone of Depression Model (Thiem)

Bob Nicholson, USGS

- A published model (by Gunther Theim) was "enhanced" to provide a better match to the MODFLOW technique for use throughout the Pinelands where mod flow is not currently available

- Very comparable results were achieved, except in areas with multiple clay layers

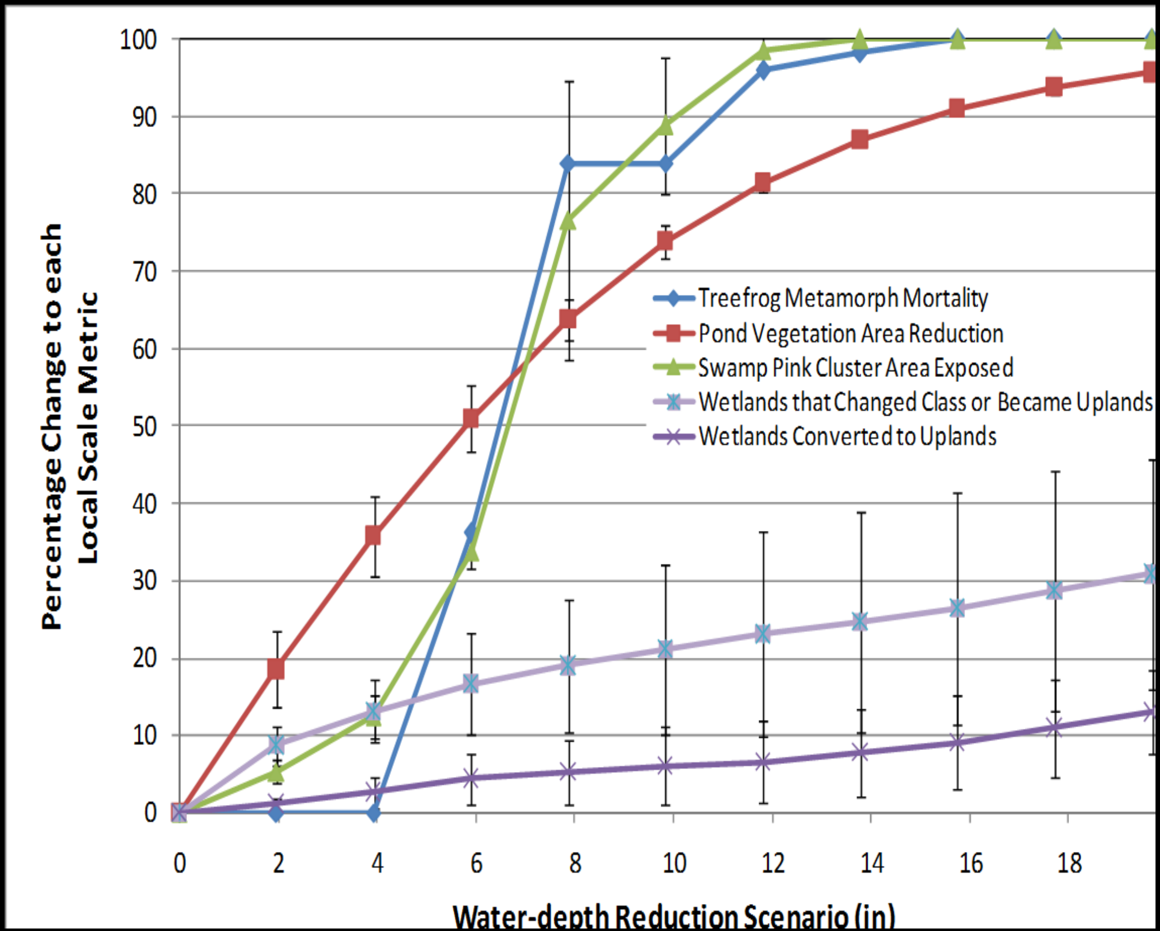
Cone of Depression



ASSESSING LOCAL IMPACTS

Overview → <u>Cone of Depression Model (Thiem)</u>

Maximum Drawdown: Some Wetlands more sensitive than others



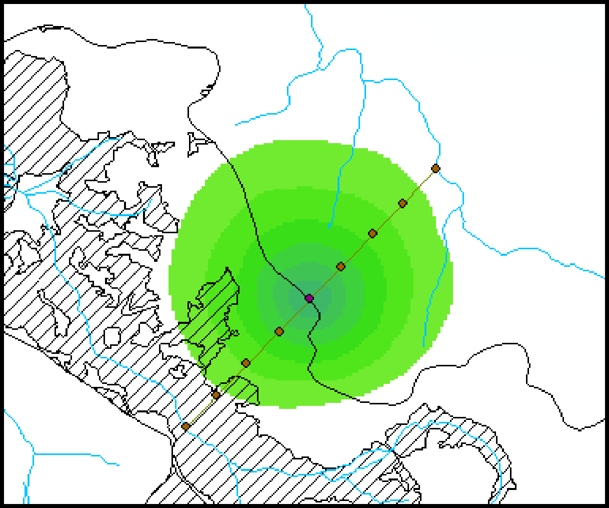
- Ponds & Pine Barrens Tree Frogs: Max 3-4" drawdown
- Other wetlands: Max 6" wetland

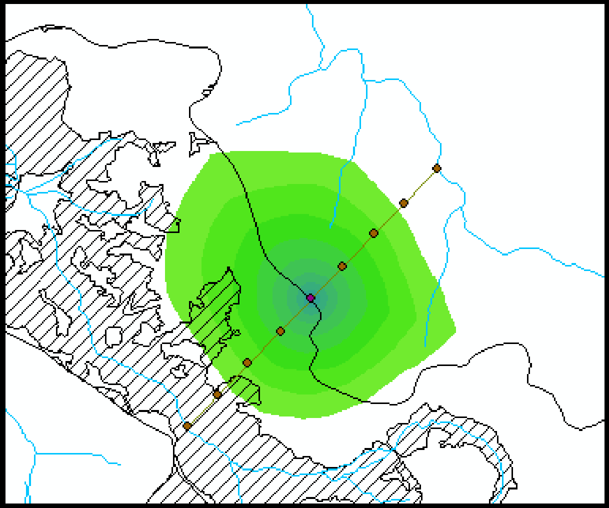
ASSESSING LOCAL IMPACTS

Overview → Cone of Depression Model (Thiem)

Measuring Drawdown Impacts

- MODFLOW Model
  - Complex, needs lots of data
  - So called "gold standard"
- Cone of Depression Model (Thiem)
  - Simple
  - Applicable everywhere, except where clay is prevalent
  - Less accurate than MODFLOW





Cone of Depression Model (Thiem)

- Key points:
  - Purveyors are amenable to using the tool
  - Probably use as a screening tool
    - Cone of depression modeling first
    - Then, Enhanced Well testing to validate
- Work involved:
  - Set limits, e.g. do not use where clay prevalent
  - Test more situations where have MODFLOW
  - Extend duration of well pump tests

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Recharge - Water Quality

- Underground storage of water can be used in two ways:
  - ASR (Aquifer Storage and Recovery) potable water from wet periods to supplement dry periods , or
  - Treated wastewater for mitigation in basins over the limit (LFM)

Groundwater Recharge
Jeff Fischer, USGS

- Key points:
  - Avoid areas with clay layers (e.g., Hammonton, Buena)
  - Unregulated contaminants are a concern to water quality
  - Maintenance is important
    - Injection rates are much lower than withdrawal rates
    - Concerns with surface- and waste-water fouling, geochemical reactions, and contamination
  - A possible mitigation tool in impacted basins
- Work involved:
  - What level of remaining pollutants is acceptable?
  - Can this level be feasibly attained?

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Tying it All Together

Current CMP	Direction for K/C Amendments
1. Well location guidelines: • 300' from wetlands • Allowed in any Pinelands Management Area • Allowed anywhere in basin	1. Well location guidelines: • Cone of depression model (Thiem) sets general buffer • Allowed in RGA, Towns, and Villages • Priority of placement near bottom of basin
2. No harm to wetlands (how determine?)	2a. Cone of depression model screening 2b. Minimum 3 day well test with piezometers in wetlands
3. 10% basin withdrawal	3. 20% - 25% LFM of large basins
4. Some conservation measures	4. Rigorous conservation measures
5. Well size: no limit	5. Limit well size to , e.g. 1 mgd
6. Alternatives: "show" K/C as last resort	6. Consider more analysis of alternatives (e.g., Del. River water)